IN THE CLAIMS

1. (currently amended) A method of obtaining nuclear magnetic resonance signals from a fluid obtained from an earth formation, comprising:

   (a) conveying said fluid into a nuclear magnetic resonance (NMR) sensor in a borehole in said earth formation;

   (b) enhancing a polarization of a nuclear spin of a nucleus occurring in said fluid to a hyperpolarized state beyond that attainable for any atomic nucleus at thermal equilibrium in the applied magnetic field; and

   (c) using said NMR sensor for obtaining NMR signals from said fluid.

2. (original)The method of claim 1 wherein enhancing said polarization of said nuclear spin is based at least in part on the Overhauser effect (OE).

3. (original)The method of claim 1 wherein enhancing said polarization of said nuclear spin is based at least in part on the Nuclear Overhauser Effect (NOE).

4. (original) The method of claim 1 wherein enhancing said polarization of said nuclear spin is based at least in part on optical pumping.

5. (original) The method of claim 1 wherein enhancing said polarization of said nuclear spin is based at least in part on a Spin Induced Nuclear Overhauser Effect (SPINOE).

6. (original) The method of claim 1 wherein enhancing said nuclear spin polarization further comprises:

(i) introducing a polarizing agent into said fluid; and

(ii) polarizing a spin of said polarizing agent, and

(iii) transferring a polarization of said polarized agent to said nuclear spin.

7. (original) The method of claim 1, further comprising conveying said sensor downhole on a wireline device.

8. (original) The method of claim 1, further comprising conveying said sensor downhole on a measurement-while-drilling tool.

9. (original) The method of claim 6, wherein said polarizing agent further comprises a noble gas.

10. (original) The method of claim 9, wherein said polarizing agent further comprises xenon.

11. (original) The method of claim 1, wherein said nucleus occurring in said fluid further comprises a carbon-13 nucleus present in at least one of: i) an aliphatic hydrocarbon , ii) an aromatic hydrocarbon, , iii) a connate formation fluid, and, (iv) a mud filtrate

12. (original)The method of claim 6, wherein said polarizing said spin of said polarizing agent further comprises a spin exchange with an intermediate material.

13. (original) The method of claim 12 wherein said intermediate material comprises rubidium.

14. (original) The method of claim 12 further comprising irradiating said intermediate material with a laser to move electrons of said intermediate material to a higher quantum state

15. (currently amended) The method of claim 1, wherein obtaining said nuclear magnetic resonance signal further comprises:

i) ~~conveying said fluid within a chamber of said sensor;~~

~~ii)~~ providing a substantially homogeneous static magnetic field in said chamber;

~~iii)~~ ii) applying a radio frequency pulse sequence to said fluid with at least one transmitter; and

~~iv)~~ iii) obtaining NMR signals from said fluid in response to said radio frequency pulse sequence at at least one receiver antenna.

16. (original) The method of claim 1 wherein obtaining said NMR signals further comprises obtaining spin echo signals.

17. (original) The method of claim 16 further comprising:

(i) summing amplitudes of said spin echo measurements

(ii) spectrally analyzing said summed amplitudes;

(iii) determining whether aromatic hydrocarbons are present in said fluid sample by measuring an amplitude of said spectrally analyzed summed amplitudes at about 130 parts per million shift from a ^{13}C resonant frequency and determining whether aliphatic hydrocarbons are present in said fluid sample by measuring an amplitude of said spectrally analyzed summed amplitudes at about 30 parts per million frequency shift from said ^{13}C resonant frequency.

18. (original) The method of claim 1 wherein said NMR signals comprise a free induction decay.

19. (currently amended) The method of claim 1 wherein said NMR signals are ~~CW~~ continuous wave NMR signals ~~to obtain frequency spectra~~ from which chemical shift information is obtained to analyze the chemical composition of the sample under test.

20. (original) The method of claim 18 where the free induction decay is transformed into a frequency spectrum for analyzing chemical composition from the chemical shift information.

21. (original) The method of claim 1 wherein said NMR signals are associated with a nuclear spin of ^{13}C.

22. (original) The method of claim 15 wherein said NMR signals are associated with a nuclear spin of ^{13}C.

23. (original) The method of claim 22 wherein providing said substantially homogeneous static magnetic field further comprises using additional NMR signals associated with ^{1}H.

24. (original) The method of claim 15 wherein providing said substantially homogeneous static magnetic field further comprises using additional NMR signals associated with ^{1}H.

25. (currently amended) The method of claim 2 further comprising radiating RF into an <u>Electron Spin Resonance </u>(ESR)-active agent at an ESR frequency of said agent and thereby enhancing the spin polarization of atomic nuclei.

26. (original) The method of claim 3 further comprising changing a nuclear spin polarization of carbon-13 nuclei in said fluid by radiating RF at a NMR frequency of hydrogen nuclei.

27. (withdrawn) A method of obtaining a parameter of interest of an earth formation, comprising:

(a) using a magnet on a nuclear magnetic resonance (NMR) sensor of a downhole logging tool for aligning spins of nuclei in a region of interest of said earth formation;

(b) polarizing nuclear spins of a polarizing agent carried in a chamber on said logging tool ;

(c) introducing said polarizing agent into said earth formation and enhancing alignment of spins of said nuclei in said region of interest;

(d) applying a radio frequency (RF) pulse sequence to said earth formation with at least one transmitter on said NMR sensor; and

(e) obtaining NMR signals from said region of interest in response to said radio frequency pulse sequence at at least one receiver antenna.

28. (withdrawn) The method of claim 27 wherein said obtained NMR signals comprise a free induction decay.

29. (withdrawn) The method of claim 27 wherein said obtained NMR signals comprise spin echo signals.

30. (withdrawn) The method of claim 29 wherein said RF pulse sequence comprises an excitation pulse and a plurality of refocusing pulses.

31. (withdrawn) The method of claim 30 wherein said excitation pulse has a tip angle of substantially equal to 90^0.

32. (withdrawn) The method of claim 30 wherein said plurality of refocusing pulses have tip angles substantially equal to 180^0.

33. (withdrawn) The method of claim 30 wherein said plurality of refocusing pulses have tip angles between 90^0 and 180^0.

34. (withdrawn) The method of claim 29 further comprising using a processor associated with said logging tool for obtaining a longitudinal relaxation time (T_1) distribution of said earth formation.

35. (withdrawn) The method of claim 29 further comprising using a processor associated with said logging tool for obtaining a transverse relaxation time (T_2) distribution of said earth formation

36. (withdrawn) The method of claim 29 wherein said parameter of interest is at least one of (i) porosity, (ii) clay bound water, (iii) bound volume irreducible, and, (iv) permeability.

37. (withdrawn) The method of claim 27 wherein said polarizing agent comprises a noble gas.

38. (withdrawn) The method of claim 27 wherein said noble gas comprises Xenon.

39. (withdrawn) The method of claim 27 wherein polarizing said nuclear spins of said polarizing agent further comprises a spin exchange with an intermediate material.

40. (withdrawn) The method of claim 39 wherein said intermediate material comprises rubidium.

41. (withdrawn) The method of claim 39 further comprising irradiating said intermediate material with a laser to move electrons of said intermediate material to a higher quantum state.

42. (currently amended) An apparatus for use in a borehole in an earth formation for obtaining nuclear magnetic resonance signals from a fluid obtained from said formation, comprising:

(a) a nuclear magnetic resonance sensor;

(b) a device which enhances a polarization of a nuclear spin of a nucleus occurring in said fluid to a hyperpolarized state beyond that attainable for any atomic nucleus at thermal equilibrium in the applied magnetic field; and

(c) a processor which analyzes NMR signals obtained by said NMR sensor from said fluid.

43. (original) The apparatus of claim 42 wherein said device for enhancing said polarization of said nuclear spin uses the Overhauser effect (OE).

44. (original) The apparatus of claim 42 wherein said device for enhancing said polarization of said nuclear spin uses the Nuclear Overhauser Effect (NOE).

45. (original) The apparatus of claim 42 wherein said device for enhancing said polarization of said nuclear spin uses optical pumping.

46. (original) The apparatus of claim 42 wherein said device for enhancing said polarization of said nuclear spin uses a Spin Induced Nuclear Overhauser Effect (SPINOE).

47. (original) The apparatus of claim 42 wherein said device for enhancing said nuclear spin further comprises:

(i) an arrangement for introducing a polarizing agent into said fluid; and

(ii) an arrangement for polarizing a spin of said polarizing agent,

48. (original) The apparatus of claim 47, wherein said polarizing agent further comprises a noble gas

49. (original) The apparatus of claim 48, wherein said polarizing agent further comprises xenon.

50. (original) The apparatus of claim 42, wherein said nucleus occurring in said fluid further comprises a carbon-13 nucleus present in at least one of: i) an aliphatic hydrocarbon , ii) an aromatic hydrocarbon, , iii) a connate formation fluid, and, (iv) a mud filtrate.

51. (original) The apparatus of claim 47, wherein said polarizing said spin of said polarizing agent further comprises a spin exchange with an intermediate material.

52. (original) The apparatus of claim 51 wherein said intermediate material comprises rubidium.

53. (previously presented) The apparatus of claim 51 further comprising a laser which moves electrons from the S to the P quantum state of said intermediate material.

54. (previously presented) The apparatus of claim 42, further comprising:

i) a fluid chamber;

ii) a magnet arrangement which provides a substantially homogeneous static magnetic field in said chamber;

iii) a transmitter which applies a radio frequency magnetic field to said fluid;

iv) a receiver which obtains NMR signals from said fluid in response to said radio frequency magnetic field.

55. (original) The apparatus of claim 42 wherein said NMR signals further comprise obtaining spin echo signals.

56. (previously presented) The apparatus of claim 55 further comprising:

a processor which:

(i) sums amplitudes of said spin echo measurements;

(ii) spectrally analyzes said summed amplitudes; and

(iii) determines whether aromatic hydrocarbons are present in said fluid sample by measuring an amplitude of said spectrally analyzed summed amplitudes at a first frequency shift from a ^{13}C resonant frequency and determining whether aliphatic hydrocarbons are present in said fluid sample by measuring an amplitude of said spectrally analyzed summed amplitudes at a second frequency shift from said ^{13}C resonant frequency.

57. (original) The apparatus of claim 42 wherein said NMR signals comprise a free induction decay.

58. (original)The apparatus of claim 57 where said processor transforms the free induction decay into a frequency spectrum for analyzing chemical composition from the chemical shift information.

59. (currently amended) The apparatus of claim 42 where said NMR signals comprise a CW frequency spectrum ~~for~~.

60. (original) The apparatus of claim 42 wherein said NMR signals are associated with a nuclear spin of ^{13}C.

61. (original) The apparatus of claim 53 wherein said NMR signals are associated with a nuclear spin of ^{13}C.

62. (original) The apparatus of claim 43 wherein said NMR sensor includes a transmitter that applies an RF magnetic field to said fluid at an electron spin resonance (ESR) frequency of an ESR-active agent

63. (original) The apparatus of claim 44 wherein said NMR sensor includes a transmitter that applies an RF magnetic field to said fluid at nuclear resonance frequency of hydrogen nuclei in said fluid.

64. (withdrawn) An apparatus for obtaining a parameter of interest of an earth formation, comprising:

(a) a magnet on a nuclear magnetic resonance (NMR) sensor of a downhole logging tool for aligning spins of nuclei in a region of interest of said earth formation;

(b) a chamber on said logging tool containing a polarizating agent;

(c) a device for polarizing spins of said polarizing agent and conveying said polarizing agent into said earth formation thereby enhancing alignment of spins of said nuclei in said region of interest;

(d) a transmitter for applying a radio frequency (RF) pulse sequence to said earth formation;

(e) a receiver for obtaining NMR signals from said region of interest in response to said radio frequency pulse ; and

(f) a processor for determining from said NMR signals a parameter of interest of said earth formation.

65. (withdrawn) The apparatus of claim 64 wherein said obtained NMR signals comprise a free induction decay.

66. (withdrawn) The apparatus of claim 65 wherein said obtained NMR signals comprise spin echo signals

67. (withdrawn) The apparatus of claim 66 wherein said RF pulse sequence comprises an excitation pulse and a plurality of refocusing pulses.

68. (withdrawn) The apparatus of claim 67 wherein said excitation pulse has a tip angle of substantially equal to 90^0.

69. (withdrawn) The apparatus of claim 64 wherein said processor obtains a longitudinal relaxation time (T_1) distribution time of said earth formation.

70. (withdrawn) The apparatus of claim 64 wherein said parameter of interest is at least one of (i) porosity, (ii) clay bound water, (iii) bound volume irreducible, and, (iv) permeability.

71. (withdrawn) The apparatus of claim 64 wherein said polarizing agent comprises a noble gas.

72. (withdrawn) The apparatus of claim 71 wherein said noble gas comprises xenon.

73. (withdrawn) The apparatus of claim 64 wherein polarizing said nuclear spins of said polarizing agent further comprises a spin exchange with an intermediate material.

74. (withdrawn) The apparatus of claim 73 wherein said intermediate material comprises rubidium.

75. (withdrawn) The apparatus of claim 73 further comprising a laser for irradiating said intermediate material to cause transitions from the S to the P quantum state of electrons of said intermediate material.

76. (currently amended) A system for obtaining nuclear magnetic resonance signals from a fluid obtained from an earth formation, comprising:

(a) a logging tool including a nuclear magnetic resonance (NMR) sensor;

(b) a first conveyance device which conveys said fluid into a chamber of said (NMR) sensor;

(c) an arrangement which enhances a polarization of a nuclear spin of a nucleus occurring in said fluid to a hyperpolarized state beyond that attainable for any atomic nucleus at thermal equilibrium in the applied magnetic field;

(d) a processor which determines from signals obtained by said NMR sensor a property of said fluid; and

(e) a second conveyance device which conveys said logging tool into said earth formation.

77. (currently amended) The system of claim 76 wherein said second conveyance device ~~in (c)~~ is selected from the group consisting of (i) a wireline, and, (ii) a drilling tubular, and, (iii) coiled tubing.

78. (original)The system of claim 76 wherein said arrangement in (c) uses at least one of (i) the Overhauser Effect (OE), (ii) the Nuclear Overhauser Effect (NOE), (iii) optical pumping or (iv) Spin Polarization Induced Nuclear Overhauser Effect (SPINOE).

79. (original) The system of claim 76 wherein said arrangement in (c) uses at least one of (i) a noble gas, (ii) xenon, (iii) an alkaline metal, and, (iv) rubidium.

80. (previously presented) The system of claim 76 further comprising a laser optically pumps at least one of (i) a noble gas, and, (ii) xenon.

81. (withdrawn) A method of using a logging tool for analyzing a fluid of an earth formation, the method comprising:

(a) dissolving a polarizing agent into said fluid;

(b) using an NMR sensor on said logging tool for obtaining NMR signals from said dissolved polarizing agent.

82. (withdrawn) The method of claim 81 wherein said dissolving of said polarizing agent is done in the earth formation.

83. (withdrawn) The method of claim 81 wherein said dissolving of said polarizing agent is done in a fluid sample chamber on said logging tool, the method further

comprising recovering said formation fluid from said earth formation using a fluid sampling device on said logging tool.

84. (withdrawn) The method of claim 81 wherein said NMR signals correspond to free induction decay of a nucleus of said polarizing agent.

85. (withdrawn) The method of claim 84 further comprising chemical shift NMR analysis of said NMR signals.

86. (withdrawn) The method of claim 81 where said NMR signals comprise of a CW frequency spectrum to obtain chemical shift information.